Event History Analysis With Roman Emperor's Data

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# Introduction

This example uses data on the ages of death of Roman Emperors. Source unclear.

# Get Data

. clear all

. import delimited "https://raw.githubusercontent.com/agrogan1/newstuff/master/categorical/survival-analysis-and-event-history/emperors/emperors.csv  
> "  
(encoding automatically selected: ISO-8859-1)  
(16 vars, 68 obs)

# Date Wrangling

. \* we can't use the date() function   
. \* because it does not work  
. \* with dates prior to 100AD

. \* generate birthdate = date(birth, "YMD")

. \* generate deathdate = date(death, "YMD")

. generate birthyear = real(substr(birth, 1, 4)) // convert first 4 characters to real number  
(5 missing values generated)

. generate deathyear = real(substr(death, 1, 4)) // convert first 4 characters to real number

. \* browse name name\_full birth birthyear death deathyear

. generate age = deathyear - birthyear  
(5 missing values generated)

. \* need to recalculate age for those born in BCE

. encode cause, generate(causeNUMERIC) // numeric version of cause of death

. codebook causeNUMERIC if age != . // show values of causeNUMERIC for non missing ages  
  
────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────  
causeNUMERIC (unlabeled)  
────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────  
  
 Type: Numeric (long)  
 Label: causeNUMERIC  
  
 Range: [1,7] Units: 1  
 Unique values: 7 Missing .: 0/63  
  
 Tabulation: Freq. Numeric Label  
 23 1 Assassination  
 1 2 Captivity  
 4 3 Died in Battle  
 8 4 Execution  
 21 5 Natural Causes  
 5 6 Suicide  
 1 7 Unknown

# stset The Data

We need to stset the data so that Stata knows that this is survival data with special characteristics. For those of you have used other commands, this is similar to using svyset or xtset.

The most commonly used syntax is something like stset timevar, failure(failvar) id(id) [[1]](#footnote-25)

There are many ways to specify failvar, we outline the most straightforward. Consult Stata help for your exact situation.

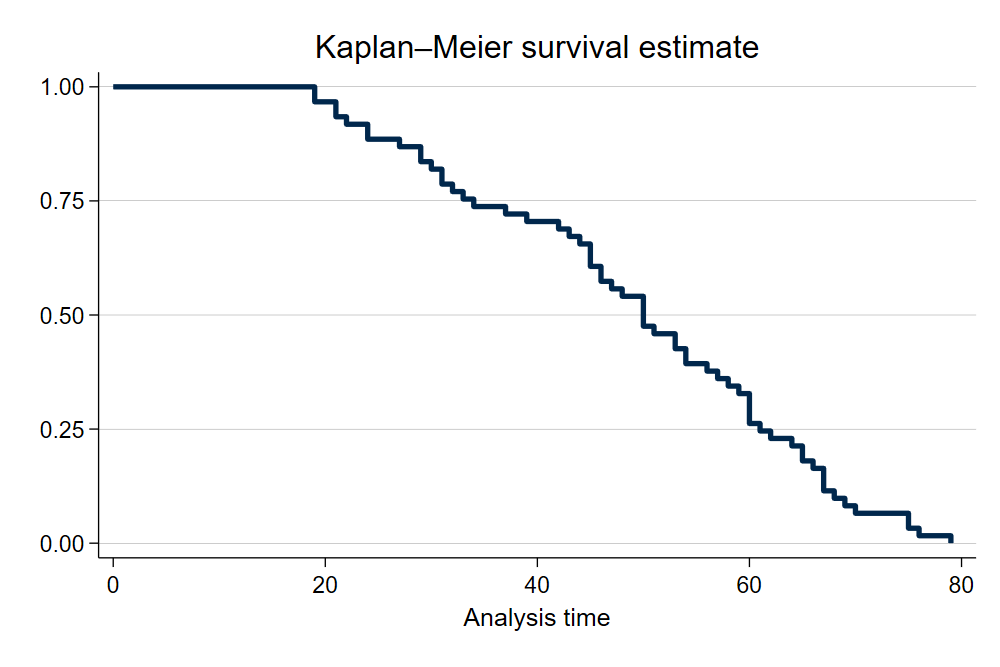
. stset age // stset the data  
  
Survival-time data settings  
  
 Failure event: (assumed to fail at time=age)  
Observed time interval: (0, age]  
 Exit on or before: failure  
  
──────────────────────────────────────────────────────────────────────────  
 68 total observations  
 5 event time missing (age>=.) PROBABLE ERROR  
 2 observations end on or before enter()  
──────────────────────────────────────────────────────────────────────────  
 61 observations remaining, representing  
 61 failures in single-record/single-failure data  
 2,984 total analysis time at risk and under observation  
 At risk from t = 0  
 Earliest observed entry t = 0  
 Last observed exit t = 79

# Kaplan-Meier Survivor Function (per Gabriela Ortiz, Stata)

## Overall Survival Function

. sts graph, scheme(michigan)  
  
 Failure \_d: 1 (meaning all fail)  
 Analysis time \_t: age

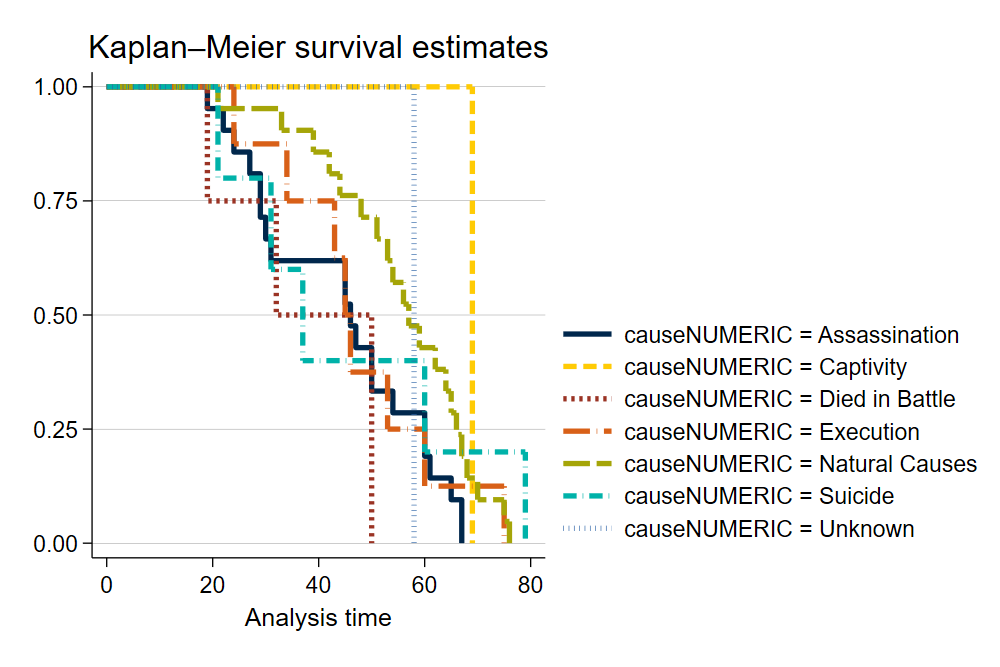
. graph export mysurvival0.png, width(1000) replace  
file mysurvival0.png saved as PNG format

{width=50%}

## Survival Function by Cause of Death

. sts graph, by(causeNUMERIC) scheme(michigan) // survival curve by cause of death  
  
 Failure \_d: 1 (meaning all fail)  
 Analysis time \_t: age

. graph export mysurvival1.png, width(1000) replace  
file mysurvival1.png saved as PNG format

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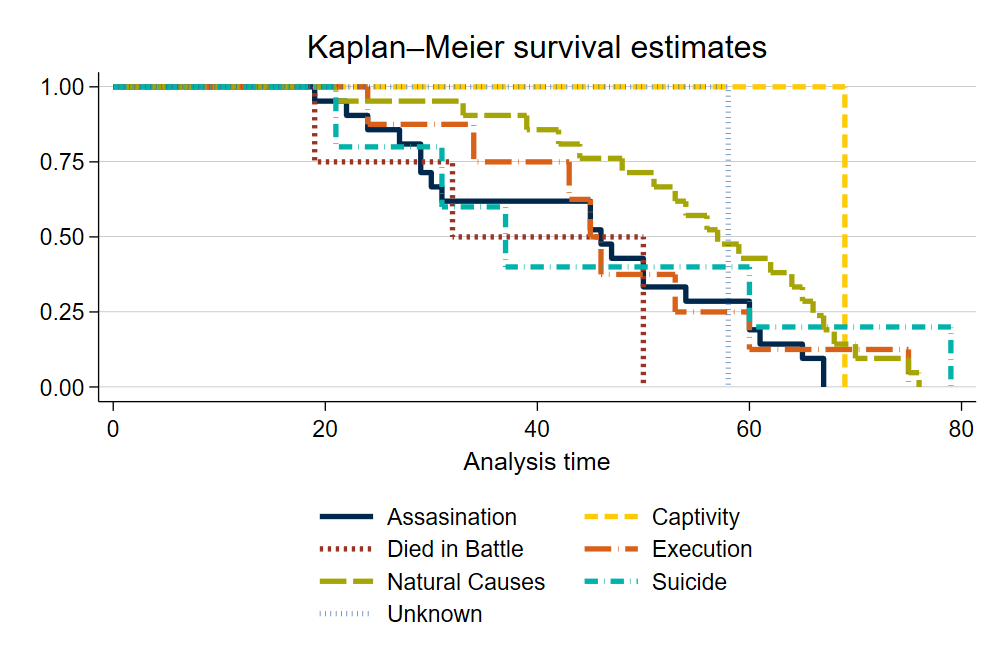
As an opportunity to take a closer look at the graph, we take a look at *cause of death* by age for those who *died in battle*.

. tabulate age causeNUMERIC if causeNUMERIC == 3  
  
 │ causeNUMER  
 │ IC  
 age │ Died in B │ Total  
───────────┼───────────┼──────────  
 19 │ 1 │ 1   
 32 │ 1 │ 1   
 50 │ 2 │ 2   
───────────┼───────────┼──────────  
 Total │ 4 │ 4

We can then work to make the legend more informative.

. sts graph, by(causeNUMERIC) scheme(michigan) ///  
> legend(pos(6) col(2) order(1 "Assasination" 2 "Captivity" 3 "Died in Battle" ///   
> 4 "Execution" 5 "Natural Causes" 6 "Suicide" 7 "Unknown")) // survival curve w better legend  
  
 Failure \_d: 1 (meaning all fail)  
 Analysis time \_t: age

. graph export mysurvival2.png, width(1000) replace  
file mysurvival2.png saved as PNG format

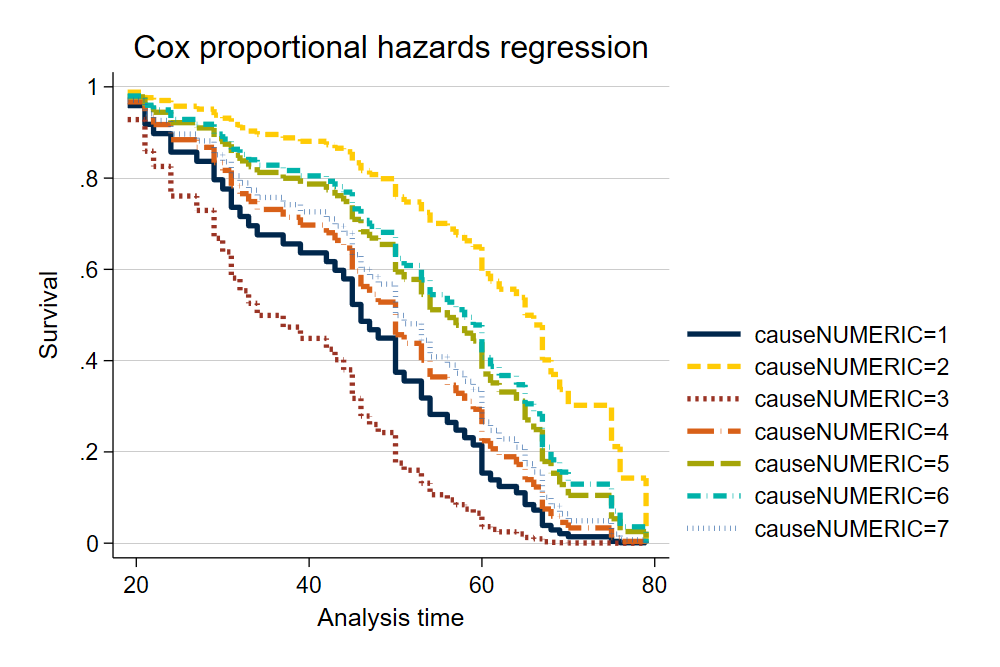
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# Cox Proportional Hazards Model

. stcox ib5.causeNUMERIC // Cox model  
  
 Failure \_d: 1 (meaning all fail)  
 Analysis time \_t: age  
  
Iteration 0: log likelihood = -194.21354  
Iteration 1: log likelihood = -190.65797  
Iteration 2: log likelihood = -190.29078  
Iteration 3: log likelihood = -190.28555  
Iteration 4: log likelihood = -190.28555  
Refining estimates:  
Iteration 0: log likelihood = -190.28555  
  
Cox regression with Breslow method for ties  
  
No. of subjects = 61 Number of obs = 61  
No. of failures = 61  
Time at risk = 2,984  
 LR chi2(6) = 7.86  
Log likelihood = -190.28555 Prob > chi2 = 0.2488  
  
────────────────┬────────────────────────────────────────────────────────────────  
 \_t │ Haz. ratio Std. err. z P>|z| [95% conf. interval]  
────────────────┼────────────────────────────────────────────────────────────────  
 causeNUMERIC │  
 Assassination │ 1.887601 .6005266 2.00 0.046 1.011828 3.521387  
 Captivity │ .5304672 .5462988 -0.62 0.538 .0704779 3.992675  
Died in Battle │ 3.344775 1.901632 2.12 0.034 1.097556 10.19313  
 Execution │ 1.506054 .6319318 0.98 0.329 .6617307 3.427677  
 Suicide │ .9063985 .5055625 -0.18 0.860 .3037693 2.704547  
 Unknown │ 1.33605 1.378549 0.28 0.779 .1768254 10.09487  
────────────────┴────────────────────────────────────────────────────────────────

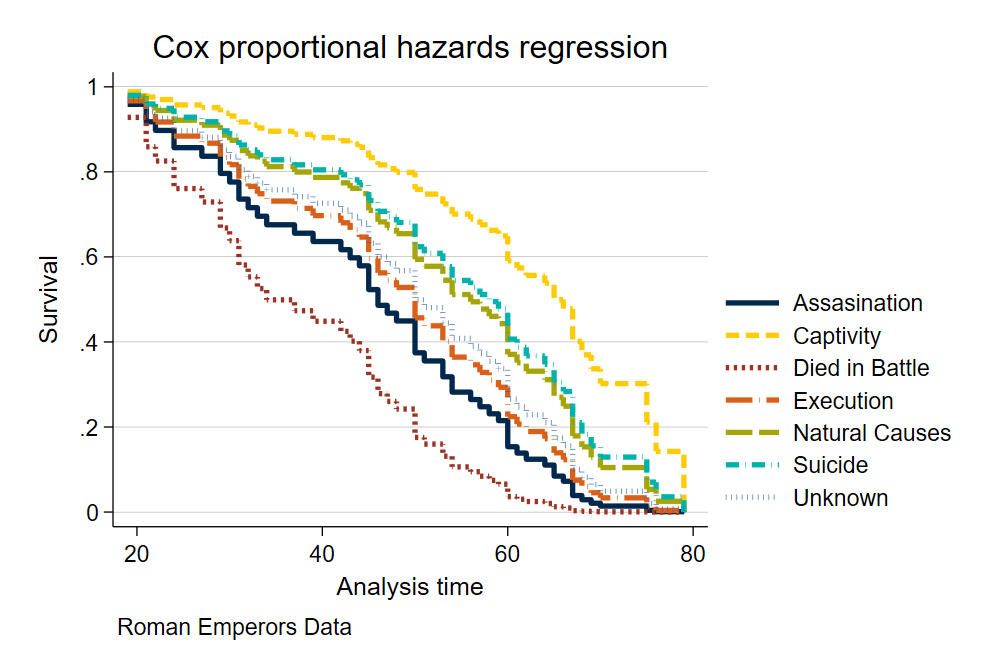
. stcurve, survival at(causeNUMERIC=(1(1)7)) ///  
> scheme(michigan) // basic survival curve by causeNUMERIC

. graph export mycox1.png, width(1000) replace  
file mycox1.png saved as PNG format

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. stcurve, survival ///  
> at(causeNUMERIC=(1(1)7)) ///  
> caption("Roman Emperors Data") ///  
> legend(order(1 "Assasination" 2 "Captivity" 3 "Died in Battle" ///   
> 4 "Execution" 5 "Natural Causes" 6 "Suicide" 7 "Unknown")) ///  
> scheme(michigan) // more nicely formatted survival curve

. graph export mycox2.png, width(1000) replace  
file mycox2.png saved as PNG format

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1. failvair is often something like died. [↑](#footnote-ref-25)